

CLAIMS

We claim:

1. A microfabricated Bragg channel waveguide of semiconductor-compatible materials, comprising:

a trench having a hollow core embedded in a substrate for the propagation of an optical wave therein, and

5 a multilayer dielectric cladding disposed on the inner wall of the trench, the cladding comprising at least one alternating layer of a first dielectric material having a high index of refraction and a second dielectric material having a lower index of refraction, such that the thicknesses of the alternating layers satisfy the condition for minimum radiation loss at the wavelength of the optical wave.

2. The microfabricated Bragg channel waveguide of claim 1, wherein the semiconductor-compatible materials comprise silicon-based materials.

3. The microfabricated Bragg channel waveguide of claim 2, wherein the silicon-based materials comprise single crystal silicon, polysilicon, silicon dioxide, silicon nitride, silicon oxynitride, or silicon carbide.

4. The microfabricated Bragg channel waveguide of claim 1, wherein the semiconductor-compatible materials comprise group II-VI or group III-V compound-based materials.

5. The microfabricated Bragg channel waveguide of claim 1, wherein the hollow core has a cross-section of dimension less than 1 millimeter.

6. The microfabricated Bragg channel waveguide of claim 1, wherein the hollow core has a cross-section of dimension less than 200 micrometers.

7. The microfabricated Bragg channel waveguide of claim 1, wherein the thickness of the first cladding layer is less than 1 micrometer.

8. The microfabricated Bragg channel waveguide of claim 1, wherein the thickness of the first cladding layer is less than 0.1 micrometers.

9. The microfabricated Bragg channel waveguide of claim 1, wherein the at least one alternating layer comprises less than five alternating layer periods.

10. The microfabricated Bragg channel waveguide of claim 1, wherein the hollow core is filled with a material having an index of refraction less than the index of refraction of the first dielectric material.
11. The microfabricated Bragg channel waveguide of claim 1, wherein the hollow core is filled with a material having an index of refraction greater than the index of refraction of the first dielectric material.
12. A microfabricated Bragg fiber of semiconductor-compatible materials, comprising:
- a tube having a hollow core for the propagation of an optical wave therein, and
 - 5 a multilayer dielectric cladding disposed on at least one wall of the tube, the cladding comprising at least one alternating layer of a first dielectric material having a high index of refraction and a second dielectric material having a lower index of refraction, such that the thicknesses of the alternating layers satisfy the condition for minimum radiation loss at the wavelength of the optical wave.
13. The microfabricated Bragg fiber of claim 12, wherein the semiconductor-based materials comprise silicon-based materials.
14. The microfabricated Bragg fiber of claim 13, wherein the silicon-based materials comprise single crystal silicon, polysilicon, silicon dioxide, silicon nitride, silicon oxynitride, or silicon carbide.
15. The microfabricated Bragg fiber of claim 12, wherein the semiconductor-compatible materials comprise group II-VI or group III-V compound-based materials.
16. The microfabricated Bragg fiber of claim 12, wherein the tube has wall thickness less than 1 micrometer.
17. The microfabricated Bragg fiber of claim 12, wherein the hollow core has a cross-section of dimension less than 1 millimeter.
18. The microfabricated Bragg fiber of claim 12, wherein the hollow core has a cross-section of dimension less than 200 micrometers.

19. The micorfabricated Bragg fiber of claim 12, wherein the thickness of the first cladding layer is less than 1 micrometer.

20. The microfabricated Bragg fiber of claim 12, wherein the thickness of the first cladding layer is less than 0.1 micrometers.

21. The microfabricated Bragg fiber of claim 12, wherein the at least one alternating layer comprises less than five alternating layer periods.

22. The microfabricated Bragg fiber of claim 12, wherein the hollow core is filled with a material having an index of refraction less than the index of refraction of the first dielectric material.

23. The micorfabricated Bragg fiber of claim 12, wherein the hollow core is filled with a material having an index of refraction greater than the index of refraction of the first dielectric material.

24. A method for fabricating a Bragg channel waveguide of semiconductor-compatible materials for propagation of an optical wave therein, comprising:

- a) coating a top surface of a substrate with a mask layer of a structural material,
- b) forming an opening in the mask layer,
- c) etching a trench in the substrate through the opening in the mask layer, and
- d) coating the inner wall of the trench with a multilayer dielectric cladding.

25. The method of claim 24, wherein the coating step d) comprises sequentially depositing at least one alternating cladding layer of a first dielectric material having a high index of refraction and a second dielectric material having a lower index of refraction, such that the thicknesses of the at least one alternating layer satisfy the condition for minimum radiation loss at the wavelength of the optical wave.

26. The method of claim 25, wherein the at least one alternating cladding layers are selected from the group of silicon-based materials consisting of polysilicon, silicon dioxide, silicon nitride, silicon oxynitride, and silicon carbide.
27. The method of claim 24, wherein the coating step d) comprises chemical vapor deposition.
28. The method of claim 24, wherein the structural material comprises silicon dioxide, silicon nitride, silicon oxynitride, or silicon carbide.
29. The method of claim 24, wherein the substrate comprises single crystal silicon or gallium arsenide.
30. A method for fabricating a Bragg fiber of semiconductor-compatible materials for propagating an optical wave therein, comprising:
- a) forming a trench in a substrate,
 - b) coating the inner wall of the trench with a first layer of a structural material,
 - c) filling the structural material-lined trench with a sacrificial material to leave an exposed deposit surface,
 - d) coating the deposit surface of the sacrificial material with a second layer of the structural material,
 - e) removing the sacrificial material to leave a hollow tube of the structural material in the trench,
 - f) removing the substrate to leave a hollow tube of the structural material, and
 - g) coating at least one wall of the hollow tube with a multilayer dielectric cladding.
31. The method of claim 30, further comprising polishing the deposit surface prior to coating step d).

32. The method of claim 30, wherein the coating step g) comprises sequentially depositing at least one alternating cladding layer of a first dielectric material having a high index of refraction and a second dielectric material having a lower index of refraction, such that the thicknesses of the at least one
5 alternating layer satisfy the condition for minimum radiation loss at the wavelength of the optical wave.

33. The method of claim 32, wherein the at least one alternating cladding layer is selected from the group of materials consisting of polysilicon, silicon dioxide, silicon nitride, silicon oxynitride, and silicon carbide.

34. The method of claim 30, wherein the coating step g) comprises chemical vapor deposition.

35. The method of claim 30, wherein the forming step a) comprises wet or dry etching of the trench through a patterning mask.

36. The method of claim 30, wherein the substrate comprises single crystal silicon or gallium arsenide.

37. The method of claim 30, wherein the structural material comprises silicon dioxide, silicon nitride, silicon oxynitride, or silicon carbide.

38. The method of claim 30, wherein the sacrificial material comprises polycrystalline silicon.

39. A method for fabricating a Bragg fiber of semiconductor-compatible materials for propagating an optical wave therein, comprising:

- a) forming a mandrel of a sacrificial material,
- b) coating the surface of the mandrel with a multilayer dielectric
5 cladding, and
- c) removing the sacrificial material to leave a hollow tube of the multilayer dielectric cladding.

40. The method of claim 39, wherein the coating step b) comprises sequentially depositing at least one alternating cladding layer of a first dielectric material having a high index of refraction and a second dielectric material having

a lower index of refraction, such that the thicknesses of the at least one
5 alternating layer satisfy the condition for minimum radiation loss at the
wavelength of the optical wave.

41. The method of claim 40, wherein the coating step b) comprises chemical
vapor deposition.

42. The method of claim 40, wherein the at least one alternating cladding
layer is selected from the group of silicon-based materials consisting of
polysilicon, silicon dioxide, silicon nitride, silicon oxynitride, and silicon carbide.

43. The method of claim 39, wherein the forming step a) comprises bulk
micromachining of a {111}-oriented silicon substrate.